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Author(s): Orde Wingate
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IN SEARCH OF ZERZURA

LIEUTENANT ORDE WINGATE, R.A.

IN an age whose mechanical invention has dwarfed the dimensions of the Earth and will soon leave no corner unsurveyed, no obstacle unsurmounted, the conditions that afford the type of adventure pursued by the geographical explorer grow increasingly hard to find. The explorer of to-day is the man with a muck-rake in his hand. His dreams are of microscopic discoveries that have escaped the telescopic vision of the early travellers. He needs other qualities than those that brought success to the latter. He need have little love of danger, hardness, or solitude. Instead of throwing his imagination across a range of mountains, a waste of sand or of waters, of which nothing is certainly known, he must concentrate it on a prescribed area about which little remains unknown.

Five years of marching in the Sudan had qualified me to undertake the old type of exploration. The scientific qualifications required for the new type I did not possess. I had therefore to seek an area comparatively unexplored, and, as far as possible, impassable to mechanical transport, in the manipulation of which I was not more expert than others, and the expense of which I could not afford. The sand sea of Libya fulfilled to some extent these conditions. Until 1929 it was held to be impassable to cars. Since then Bagnold has twice crossed it from north to south, the direction of the lines of dunes; while Clayton, of the Desert Surveys, has crossed it from east to west. At the moment of writing the invention of a new type of tyre is claimed to have made possible the surmounting of sand-dunes in any direction, and the sand sea, save for one small area of chaotic dunes, has become as open to cars as the ocean to ships. There are however certain advantages in travelling on foot of which the motorist is deprived. The pedestrian is unhurried. He can stop to investigate anything of interest without upsetting his programme; and he is likely to notice detail that will escape the traveller at speed, a matter of some importance in a waste whose utter emptiness makes the minutiae of nature of more interest than the general geographical features.

So empty and void of interest is the sea of sand that even the most enthusiastic of explorers would hesitate to venture himself among its heartless dunes, but for two legends, still to be verified, that lend to it a romantic interest. The first is the story of Cambyses, of whom Herodotus relates that in the year 525 B.C., being rewarded with madness for the killing of the Apis, he set out to the conquest of Nubia. And, on the way, hearing of the riches in the temple of Jupiter Ammon at Siwa, he detached an army of 50,000 Persians to march there by way of the Great Oasis. This they reached and presently set out across the sands to go to Siwa, led by Egyptian guides. After three days a sandstorm arose and annihilated them. Somewhere in the sand sea their bones, swords, and armour await the arrival of the man who is destined to recall to a softer generation the memory of their heroic failure. The second is the legend of Zerzura, the oasis of fluttering birds, or of the blacks, the only one of a number of oases referred to in old manuscripts and travellers' tales that has not been identified. The chances of finding either are so small that no one who did not love exploration for its own sake would ever trouble his head about them. For me the sand sea had the further advantage of lying almost entirely within Egyptian territory, thus obviating the political obstacles to travel in other countries; I could employ camel transport, to which I was accustomed, and I spoke the language.

Having chosen the area of operations I had to select a definite itinerary, arrange transport, equipment, and personnel, obtain and master the use of certain surveying instruments, acquire such smattering of geological and archaeological learning as would enable me to observe and record points of interest coming under these headings, apply for leave, and, most difficult of all, keep the total expenditure within the limits of my means. In the achievement of these ends I met with much help and encouragement from various sources. The Royal Geographical Society not only engaged to supply me with surveying instruments but sent them to me, at my request, several months before I was due to start; in order that I might find an opportunity of learning their use when on the march on the Abyssinian frontier.

An account of the preparation for an enterprise possesses little interest for the general public, but, for the few who are hoping to attempt something similar, the preparation is of more importance than the execution. For this reason I propose to devote some space to a description of the difficulties I encountered and how I surmounted them.

To begin with there was the question of transport. I had decided that this was to be by camels. The advantages of camel over motor transport appear at first sight to be negligible, and undoubtedly the two methods are not comparable from a commercial standpoint. Cars are faster, require less attention, can be procured to specification, relieve the traveller of nine-tenths of the tedium and heartbreak of the journey, multiply his radius of action by five or six times, and make possible a far greater measure of personal supervision with its corollary of self-reliance. Against all these advantages, the personal preference of the individual traveller for camels will have little weight with those who do not share it. There remains therefore one single advantage to be weighed. At first sight it appears pure disadvantage, and it is only experience that can teach its value. Whether this is enough to outweigh the rest depends wholly on the nature of the enterprise and the character of the adventurer. This single advantage lies in the slower and more leisurely rate of progress of the camel when compared with the car.

If the object be purely to cross a waste, then the slowness of the camel is simply a disadvantage. The only exception is when the waste is one of sand-dunes lying at right angles to the line of march; but with the adoption of 12-inch and even larger diameter tyres it is doubtful whether this still holds good. But if the object is to search for something in the wilderness, and, stunts apart, this will generally be the case in serious enterprises, the question must be reviewed in the light of the conditions, and the verdict may well be given in favour of camel transport.

Take, for example, the search for artefacts in the Libyan desert. A man in a car will never see an artefact while driving, which means that he must stop and get out to look. He will not do this if "making his point" for the day, and, in any case, can only do so at long intervals and in what he considers likely places. As his views on the latter point are far more likely to be wrong than right, his chances of finding a fair proportion of the artefacts he drives over are small in the extreme. It is true that Bagnold's well-equipped expeditions succeeded in finding large numbers of these artefacts; but almost entirely, I think, where they are most easy to find—off the great sand sheets and south of the 27th parallel. The occasional artefact that occurs in the sands of the northern desert would be missed by the occupant of a car because there is nothing to betray its presence and it is itself very inconspicuous. Yet it has a far greater interest. Again, such points as probable sites for artefacts and the occurrence and cause of soft patches in sand will be more adequately examined by the man who travels slowly, and on foot, than by the man whose contacts with the surface he is investigating occur at 20-mile intervals. A further point in favour of camels is the sense of unlimited leisure which they impart to the undertaking. No schedule need be adhered to, no time-table observed. Distances are measured in days instead of in miles; and the effect of all this on the mind of the traveller is to make him less hurried and more deliberate. As he trudges slowly through the sand his mind chews the cud of his observations, untroubled by the adventurous progress of the internal combustion engine.

Camels vary enormously in capacity, and what is true of one breed will not be so for another. For example, whereas Bertram Thomas and Philby appear to have relied entirely on sporadic grazing for the support of their animals, which were the property of the Arabs who accompanied them, the camels which for centuries have been used to cross the pastureless wastes of the sand sea are accustomed to carry their food on their backs. The disadvantages of the method employed by the explorers of the Rub' al Khali is sufficiently illustrated by their experiences. They were both to some extent, Philby to a very large extent, at the mercy of Arab tribesmen, owners of their camels, men whose sole motive was avarice, who were unaccustomed to obey any one, and for whom the strongest argument against an enterprise was its danger. Both seem to have regarded guides as a necessity: the reason for this being possibly their desire to visit places such as Wabar, known to them and to the world only by repute. In an expedition of the Bagnold type a guide would merely prove an encumbrance. Philby's transport seems to have consisted of *nagas*, which were constantly incommoded by the pangs of parturition. Their milk formed a staple portion of his diet. Their performance under these conditions is remarkable. He seems to have regarded 20 to 30 miles a day as a good average for his baggage animals, while the riding camels could cover over 50 miles. These figures are not very different from those obtaining in the Sudan and elsewhere. A laden camel will march at 2 miles an hour for twelve hours a day indefinitely. Any attempt to hustle it leads to disaster.

For travel in the Northern Libyan Desert two types of camel are available: the Maghrabi, and the Egyptian hill camel. The latter is a poor substitute for the former, with which the Senussi were formerly wont to make their astonishing journeys, but which will generally prove unobtainable for the chance traveller. It is impossible to buy a camel to-day and embark on a journey to-morrow. A long period of training must precede effort, and months will generally be required to collect and harden the animals if the best results are to be obtained.

The Senussi Maghrabi is credibly reported to be capable of 30 miles a day over bad going, up to an easy maximum of fifteen days without water or grazing, in cold weather. Naturally some kind of forage has to be carried, and the Senussi use dates and a small quantity of *tibn*, or chopped straw. This performance is, so far as I am aware, unequalled by that of any other known breed of camel. With the extermination of the Senussi the breed of camel used by them for their desert journeys has nearly ceased to exist, and I found it impossible to obtain one, even with months of notice.

The Egyptian hill camel, with which my contractor provided me, is a small wiry animal used for porterage between the western oases and the Nile. When loaded, ten waterless days at 20 miles a day would appear to be an easy limit of endurance, after suitable training. A caravan of these animals would thus be quite capable of the journey from Bir Mungar to Kufra, if a few gallons of water were carried for a partial relief of thirst. But, were I to undertake a journey in these sands again, I would secure the Maghrabi breed or none at all. With them my radius of action would be doubled, my security trebled.

Desert breeds of camel will not carry loads of much over 250 lb. without taxing their strength. I think that wherever camels are used it will be found that their owners prefer to march by night and rest by day. The march is usually divided into two *shids* or periods; the first from about one hour before sunset to perhaps three hours after; the second from some four hours before dawn to one hour after. When grazing is available this programme should be modified to allow the animals to feed at sunset and sunrise. In this connection it is interesting to note the difficulty experienced by Philby in inducing his Arabs to march by day instead of by night, in order that he might see the country traversed.

The reason for this predilection is sound, as one would expect, being due simply to the bad effects of the sun by day. But in cold weather this is less applicable, and marching by day is attended with little risk. I did nine-tenths of my marching by day, and I did not unsaddle from dawn to dusk; a procedure which would scandalize the military expert of the camel corps. But nearly all such rules depend for their validity on the condition of the animal. Once get your beasts thoroughly hardened and you can ride roughshod over most of them. Government beasts are necessarily fat and scarcely ever hard, and must be treated accordingly.

The question of pack-saddles caused me some solicitude, which the event proved superfluous, as the *baladi* (native) saddles provided by the contractor—rude structures of wood and straw—proved perfectly adequate. The desiderata for pack-saddles, whether for camels or other animals, are three in number, and, generally speaking, are much better met by the *baladi* than by the Government variety.

They are as follows: (1) the weight must be borne by those portions of the body most capable of sustaining it, *i.e.* kept off hump, withers, and the ends of the ribs. (2) The bearing surface cannot be too big after the first requirement has been met. (3) The bearing surface must be ventilated if swellings are to be avoided. It is in this last respect that Government pack-saddles fail so lamentably. The heavy, hair-stuffed bids allow of no ventilation of the bearing surface, except through chance shifting of the whole saddle. The straw pads employed by the Arabs, on the other hand, ensure the continual access of air to the surface under pressure, and swellings with them are invariably due to carelessness on the part of the Arab in allowing the wooden structure to bear down on the back.

In the matter of forage, the only rule is to feed whatever the animals are accustomed to eat. Naturally, in the absence of grazing they must be accustomed to a grain ration by a period of training. Camels will eat a surprising variety of food, but care must be exercised in the desert to see that they do not eat what will cause thirst. Philby quotes an example of this on p. 117 of his book. His camels had eaten freely of a saline herb with the result that they were already thirsty thirty-six hours after watering—five days of endurance of thirst thrown away in a single meal.

To conclude these remarks on camel transport I will describe the ideal method of obtaining and training it; an ideal that should not be impossible of achievement to any one who has the necessary time to devote to it. Having selected the area in which you propose to travel, find out the local breed with the highest reputation for endurance. Do not expect looks. The best desert camel is a miserable creature, spare and lightly built. Purchase as many animals as you require and hire men of the tribe that breeds them to look after them for you. Put them through a programme of training for perhaps a month, with a view to developing their endurance, and you will then have an instrument on which you can rely and whose capacity is perfectly known to you.

I would recommend that the caravan should be as small as possible. Numbers only multiply disasters and lessen your own authority. They are supposed, in desert Arabia, to constitute safety, but, to judge from the accounts of Philby and Thomas, the numbers in whose caravans, although large, were insufficient to secure them from attack, whilst far too large for efficiency or control, this belief, so far as the European is concerned, is ill considered. If attack were to be made by a large body of marauders I should personally feel quite confident of repulsing it with four ·303 rifles and ample ammunition, all under my personal command; whilst I should fear defeat with no better weapon than a mob of excitable Arabs, armed with inferior rifles which they were unable to use. The desert affords an unrivalled field for the use of the accurate long-range weapon in the hands of those who can use it. Further, the Arab raider does not expect to be killed, a misfortune he will do much to avoid.

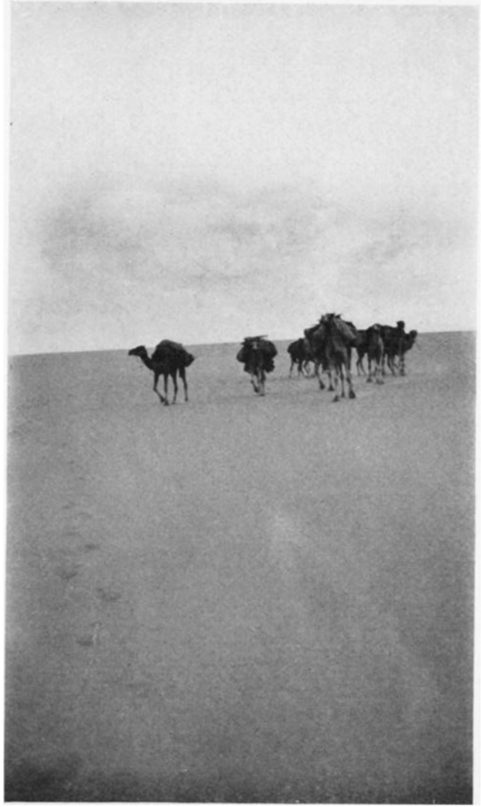
Having failed to obtain Maghrabi camels, and being forced to rely entirely on my contractor, I was fain to make the best of the Egyptian hill camels he provided. I grew to respect their powers of endurance, although their leisurely and complaining progress was an unfailing source of irritation to me.

Having made the best arrangement for transport possible under the circumstances, I could devote all my energies to the collection of the necessary equipment, and to qualifying myself to carry out the indispensable work of surveying my route and noting points of obvious geological and archaeological interest.

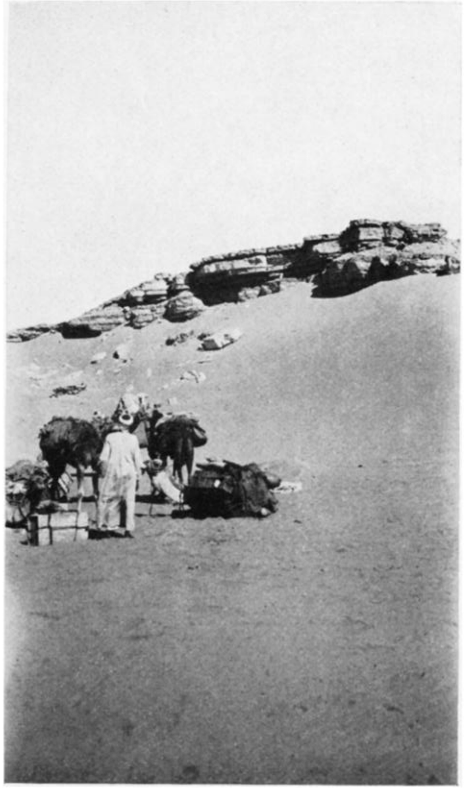
From the Royal Geographical Society I had obtained a 6-inch transit theodolite, a Watkins mountain aneroid, a half-chronometer, a plane table, etc. Later I added to these a larger aneroid to detect smaller differences in height, a couple of prismatic compasses, and a wheel with two revometers. These were lent me by the Survey Department. I had had no experience of the theodolite, and was faced with the necessity of teaching myself with the aid of Close's text-book of topographical surveying, the Nautical Almanac, and Shortrede's Tables, to make astronomical observations and to use trigonometrical formulae. I carried my instruments with me on a number of marches I made on the Abyssinian border in November and December 1932, and I succeeded in learning enough for my purpose. By January I could find local mean time, set the theodolite in azimuth, and find latitude by three methods. Mr. Grabham, the Sudan Government geologist, provided me with a simple primer on geology and with a box of specimens that were of great use in informing my mind, completely blank hitherto on this subject. I also read Kroeber's 'Anthropology,' and 'Notes and Queries on Anthropology.' These gave me some idea of what to look for in the way of stone artefacts, etc., and of the most likely places in which to find them.

There remained the questions of food and drink, of personal equipment, of comforts, and of clothing. As the first two of these considerations, and consequently the number of camels required, were dependent on my itinerary, I had to decide upon the latter as soon as possible. At that time the portion of the sand sea that had not been searched for Zerzura was roughly bounded by latitudes 24° 30′–27° 30′, longitudes 26°–25°. The area that I finally decided to search was bounded by latitudes 26°–27°, longitudes 26°–25°. My base would be Bir Abu Mungar, and as my proposed march would lie entirely outside the neighbourhood of oases, it was necessary to form a dump of grain and water at some suitable point on the line of march to act as an advanced base. This would be maintained by a second party of men and camels working between Mungar and the dump. I determined to form the latter at a distance of four days' march due west of Mungar, to march from there on a bearing of 315° for two days, turn south for one day, and so back to the dump by a detour, arriving there on the eighth day after leaving it. The replenishing party would arrive on the same day, and, after watering and resting, I proposed to repeat the previous march on a bearing of 225°, turning north after two days, and so home. Having made the necessary calculations, I was able to fix the number of camels at thirteen, with four Arabs to tend them. I further estimated the period during which I should be absent from Dakhla at forty days. I decided against riding camels because I could not supervise their training. Baggage camels of suitable type are more easily obtained and their condition does not matter to the same extent. Also there was the question of expense to be considered.

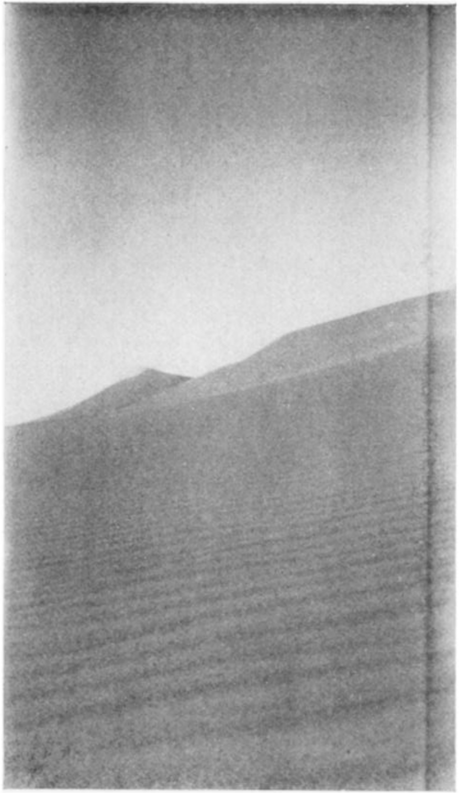
On casting up an account of all probable expenses incurred on the above counts I found that I had left very little from which to provide my own food and equipment. I had allowed myself one camel to carry my boxes of instruments, clothes, food, and bedding. Thus, out of a total load of 250 lb. I could allow 80 lb. for food, and 20 lb. for bedding and clothing. I did not, of course, take a bed, table, or chair, and I decided to dispense altogether with cooking. My staple diet was to be dates, biscuit, and cod-liver oil. I added to these essentials 1 lb. of chocolate, 10 lb. of raisins, two ½-lb. tins of grapefruit, and a tin containing nearly 10 lb. of wholemeal flour.



30 miles north-west of Regenfeld



Camp 70 miles south of Bir Mungar



"Seif" in a sandstorm: sand in foreground carried clear of the ground by wind

Hard limestone country 20 miles west of Bir Mungar

Bir Mungar: the well is beneath the date palm

Preparing for the start from Bir Mungar

For clothing I decided to wear the Arab *gibbah*, or shirt, the *immat*, or turban, over bush shirt and shorts. My legs were bare, my feet in sandals of a type similar to those used by members of Bagnold's last expedition in 1932, a specimen of which I obtained from Prendergast in Khartoum and had copied locally. There are two main considerations affecting the choice of clothing for use in the sand sea; protection from the sun and protection from the cold. The first was obtained by the means I employed, but the second was very inadequately provided, and cold proved to be one of my principal hardships.

On 21 January 1933 I left my station in the Sudan for Khartoum, where I proposed to spend a few days in final preparations and in drawing up a surveying programme, with the help of the Sudan Government Survey Department. This help was very kindly given and my instruments were adjusted and put in order. Here I bought my 80 lb. of food, my sandals and clothing, and on January 28 I left Khartoum for Egypt, taking with me everything I needed for my journey, barring men, camels, and grain. I would meet them at Dakhlat, as arranged.

Late at night on February 1 I descended from the Cairo express at Oasis Junction, and, embarking on the motor trolley I found awaiting me, went straight to the village of Qara, where I spent the night in the Resthouse. Early next morning we set out for Kharga by the desert line that scales the broken limestone scarp of the plateau dividing the oases's depressions from the Nile valley. It was my first acquaintance with the western desert, but I was less impressed by its vast solitudes than I would have been had my mind been less occupied with speculations as to when the trolley would jump the rails. The driver, with characteristic Egyptian nonchalance, appeared to be guided by one principle only. This was to go as fast as the engine and gradient would permit at any given moment. The speed we acquired when descending the more violent slopes would have qualified us to enter for the Schneider Cup. On the whole however he displayed great skill at cornering, and a catastrophe was averted. Out of the corner of my petrified eye I got my first glimpse of dunes, but my imagination was not free to dwell on the spectacle they presented. In due course the palms and *berseem* of Kharga emerged from the depths ahead, presently we were passing a Roman temple, and, a little later, were pulling up at the platform of Kharga station, where a very courteous Governor, Mohammed Bey Wasfi, was waiting to greet me. He carried me off to his house for an excellent lunch and made me very welcome.

I arranged to transfer myself and baggage to Dakhlat that night, hiring a Ford tourer and lorry for the purpose at the modest charge of £7, and at 2 p.m. we set out. Traces of the British wartime occupation are still numerous on the road to Dakhlat, which is marked chiefly by car tracks in the sand. My owner-driver, Ahmed Hamed, was full of his war experiences, and the time passed pleasantly until we reached Bilat, a village of Dakhlat, whose Omda was known to be good for a cup of tea. It is customary in these oases, when approaching human habitations in a car, to depress the button of the electric horn and to keep it depressed until the entire population is assembled to greet you, and to answer any inquiries you may wish to make. It struck me at first as discourteous, but I found that this was merely the prejudice of ignorance, and that the kindly peasantry would be hurt by any omission of the popular practice. There is real enchantment in the appearance of these huddled villages of mud brick. They are all, or nearly all, built on mounds formed, no doubt, of the remains of past villages, and they have a castellated effect that suggests knights in armour. In the dusk standards of size are somehow annihilated, and one receives the impression of a gigantic and labyrinthine castle standing on a hill, surrounded by Brobdignagian date palms and pleasant gardens with running brooks.

The Omda's resthouse for travellers was vigorously painted in reds, ochres, and greens. It abounded in cushions and couches and proved a very comfortable place for rest and refreshment. We spent that night at Mut, and early next morning we started for Qasr, where we had news of my camels. After a pleasant drive through the cultivation we drew up outside the mud walls of the township and alighted. A considerable group of notables was waiting to receive us, among whom I found my contractor, Mansour el Ghamia, commonly called Mansour Bey, a tall talkative man with mobile aquiline features, a sort of cross between James More and Guy Fawkes.

The Omda led us through the crooked, overbuilt lanes of the town to the guesthouse, where we had coffee and oranges. The oranges of Dakhlat will one day be famous. When fresh they have a fragrance that must be experienced to be appreciated. I bought a hundred of them on the spot for two shillings, and thought them worth that apiece.

Being impatient to see my camels and camelmen I insisted on going down to them at once; instead of waiting until the morrow, as strongly urged by all present. I found them collected on the sand under the north wall of Qasr, disconsolately chewing some ends of straw. The success of my journey depended almost entirely on these creatures, and I viewed them with misgiving. Judged by Sudan standards they were wretchedly small and weak. But I knew enough of camels to know that I knew nothing, and accepted with reservations Mansour's assurances that they were the very type I wanted for the sand sea.

Here, too, I met for the first time my comrades for the next five weeks. I scanned their features with interest, but without much acumen, as the upshot was to prove. They were four in number. The first to be introduced was Es Senussi Abdullah, a thick-set, sturdy Zuweia of Kufra. He had owned slaves and oliveyards in that remote refuge of the Senussi, until the advance of the Italians had forced him to abandon his patrimony and fly, with what movables he possessed, to Egypt. Twenty times he had made the journey from Kufra to Bir Mungar, ten times from Siwa to Kufra, and he knew all the Arab desert lore. His square and open face had character and courage, and in him, I felt, I should have some one on whom I could rely. The second to shake hands with me was Abd Er Rahman Saleh, a nephew of Mansour, and who was intended, I was informed, to perform the offices of friend and confidant. He seemed a sturdy honest sort of a man, and I felt I should like him. Abu Bekr Guweia, the third to be introduced, was a lean lanky figure of a man, with a rather feline expression. I concluded that he would prove a source of trouble and anxiety. The fourth was a mere boy, one Suleiman Foula, a near relation of the Abu Bekr, with a craving for cigarettes. He appeared to me to be a poor specimen and not at all suitable for the occasion.

Altogether my heart rather failed me on this first inspection of the material with which my journey was to be made. I had however no alternative but to accept it as it stood or to abandon my plans altogether. After a midday meal of chicken and oranges at the Omda's we began our final preparations for the march. I put on the clothes I was to wear for the ensuing five weeks and arranged the distribution of the loads. There was the usual disputation and confusion, without which nothing can be accomplished, and at five in the afternoon we got to our feet, took a last look at Qasr, and climbed the first dune of the many that separated us from our objective.

I was prepared for delays on this occasion but they exceeded even my most despondent estimate. Everything fell off, and while it was being tied on, the waiting camels would wander towards anything that looked edible, and minutes would be lost in collecting them again. Not wishing to lose my temper, I walked on with Es Senussi. He told me that he did not think much of the camels, that only himself and possibly Abu Bekr knew anything about the desert, and added that, in his opinion, the forage we were taking was insufficient. This was a sore point. I had stipulated for seven *ardebs* to be sent ahead to Bir Mungar, but it had not been done. Mansour had explained that it was unnecessary as we had enough with us to last for forty days. As he had not even weighed it I had little faith in his opinion, and I ordered Suleiman to run back to Qasr to fetch him. In due course he arrived in a Ford car, just as we topped the last dune before Sheikh Maihub. He announced that he supposed I had sent for him in order to make him a handsome present in token of my satisfaction, and was proportionately depressed to hear that he had to send seven *ardebs* of grain to Mungar at once as per contract.

At Sheikh Maihub (Sheikh Ibrahim on the maps) we stopped for the night and camped on a strip of clean sand, beside some tamarisk scrub. I had my boxes unloaded beside me and applied myself to the task of making a bed and preparing a meal. Unaccustomed as I was to the work, it was a full hour before I was able to lie down on my blankets under the stars and begin the arduous process of eating my way through a handful of dried dates, as hard as cardboard. A few biscuits and an orange completed the meal, and I was presently uncomfortably asleep. At two in the morning I woke up. It was bitterly cold, and my exposed side was stiff and aching. Reaching for the thermometer I found it to read 33° F. Foolishly, I had brought only three blankets, of which one was underneath me, and after huddling on every article of clothing I possessed, including towels, I was still cold and unable to sleep. Dawn put an end to my discomfort, and when the red disc of the sun had just cleared the dune to the east I was more than ready for the march. After the inevitable delays, we set out for Gebel Edmonstone.

This first stage of our journey was useful for testing my instruments. The route was marked on the map and I was able to check my computations. I had brought with me a bicycle wheel for measuring the distance marched. Something of the kind was necessary because, in the absence of wireless time signals, I could only get reliable latitudes from my theodolite. My means would not run to a wireless set. So for longitude I was dependent on the accuracy of my estimate of distance covered. Camel pace is irregular and difficult to gauge. In marching the odd 100 miles from Qasr to Bir Nungar I had an excellent opportunity of obtaining a good value for my wheel. This value I was later able to check, thanks to meeting one of Clayton's fixed points, and found it unexpectedly accurate. It gave an error of only 2½ miles over a march of 130 miles. By the offer of a small reward I had induced an Arab to undertake the pushing of this wheel, but I soon observed that his methods were not reassuring. When he was not zigzagging like a snake he would be running off the track to head off a stray camel, or to collect firewood. I decided to take the wheel myself and kept it until we returned to Qasr five weeks later. I soon grew accustomed to it, and for weeks after I had sent it back to the Sudan I used to feel as if I were improperly dressed when I went for a walk without it.

On that first day of marching we moved with impressive deliberation. The going was a sort of dry sludge of fine sand and black stones. A few miles to our right stretched the broken cliffs of the limestone plateau that lies north-west of Dakhlat. Our movement with relation to this feature was imperceptible. Gebel Edmonstone took up a position shortly to our rear and obstinately refused to retire into the distance. The whole landscape gave an impression of decay. Everything was falling to bits and had been doing so for ever. With infinite labour we trudged on in a motionless landscape. Heavily laden, the camels could cover scarcely 2 miles in an hour, and sunset found us only 19 miles from our start.

During these first few days I was anxious to find out, among other things, what distance the camels could comfortably cover in a day's march. I did not therefore hold them to a set programme, but allowed them to halt when they seemed to have had enough. I found the effort of marching for twelve hours from sunrise to sunset, without a halt and at a snail's pace, very trying to my powers of endurance. And when at length the interminable crawl was finished, and I could make my bed in the sand, the prospect of a dinner of biscuit and cod-liver oil was not always alluring. But I found that this diet was as well chosen as it was unpalatable; I had not an hour's illness, or threat of illness, from start to finish. The soft yielding going soon tried my feet and started rubs and blisters that became permanent. But, although exposed to the air, the wounds remained clean and wholesome until my return to Dakhlat. For dressing I used vaseline only.

We took four and a half days to reach Bir Abu Mungar. They were uneventful days. Slowly we crept along the Gilf to Kings Hills, slowly we rounded the bend to the north, and slowly we branched off through the dunes to march straight on Abu Mungar. The Senussi here gave us a demonstration of his sense of direction. He made a bee-line for the well from a point 18 miles away under the Gilf, and when, the following morning, the rising sun lit up the cliffs ahead over the rolling sand, we were found to be marching directly on the solitary palm that marks this most desolate of oases. On February 8 we reached the well at Abu Mungar at two in the afternoon. We had tested our instruments, obtained a value for the wheel, found our rate of march, and formed a fair estimate of our powers. We had now to rest, allow the camels to eat their fill of the last grazing they would get for weeks, fill our water-tanks, and set forth. I employed this interval in taking several observations for time and in checking my compass by bearings to consecutive sunrises and sunsets.

Mungar possesses only one well to-day, but to judge from the number of mounds bearing vegetation, it must have had several more in time past. It abounds in broken pottery of water vessels, but I could find nothing there of interest. It would probably be worth while to dig through some of the mounds. The site must be as old as those of the other oases and have been used from a remote antiquity. Stone artefacts have been picked up there, and thorough search should reveal matter of great interest to archaeologists. There used to be a small forest of tamarisk at the foot of the mounds, covering an area several hundred yards square, and the remains of trees of over a foot in diameter are to be found in places. But the whole place has been denuded of wood by travellers, possibly during the war, and a very meagre assortment of vegetation is to be found there to-day. The water is warm, as in all these oases, and is sweet and good. It emerges some 15 feet above the level of the surrounding flats.

My plans had been somewhat modified by the unwelcome discovery that 20 miles a day was all that I could expect from my camels, while their powers of enduring thirst were limited to seven days with comfort, to ten as a maximum. I proposed now to march on a bearing of 276° 30′ true for three and a half days, to make a dump at the point then reached, to send two Arabs and eight camels back to Mungar to bring water and grain, and to go on myself, westwards, with two Arabs and five camels for four days before turning back. I hoped to reach the frontier and the western edge of the sand sea. On my return to the dump I proposed to change camels and march for four days south-west, and then, returning *via* the dump, to go home. Once the march into unmapped country had begun my duties became more arduous. Every time that we crossed a dune or encountered some definite feature it was necessary to stop, take a note of the right and left revometer readings, and record the fact. It was necessary, too, to find some way of marking our tracks, which might be obliterated before our return. In the event they were wiped out several times a day by sandstorms, but at the start the weather was calm and had been so for some weeks. We even found tracks of a party of six men, ten camels, and one donkey, leaving Mungar for Kufra, and subsequent information showed these to be nearly a month old. I noticed that in many places on the Kufra route there were lines of camel droppings that appeared to be of uncertain age. From their numbers however I concluded that they recorded the journeyings of at the least a dozen years. This suggested to me the idea of making blobs of camel droppings at prominent points in the march. My first idea had been to take date-palm branches, like Colonel De Lancey Forth, in his march south from Siwa, but apart from the fact that they are liable to be overthrown, the number available at Mungar was small, even had we denuded the solitary palm there; a sacrilegious act I was loath to commit. My plan worked well enough, but the difficulty was to induce the Arabs to carry a sufficient quantity of droppings.

At 8.30 a.m. on February 11 we began to climb the long sand slope that introduces the traveller to the Kufra road and the sand sea. The difference in height between the summit of the first dune crossed and water-level at Bir Mungar was 410 feet, as measured by my aneroids.

The first dune of cascading crests lies about 3 miles west of the well. The *seif*, or line of cascading crests, is low and easily crossed, and its general direction is roughly 158° 30′ true. I found great difficulty in taking the direction of dunes. There is only one satisfactory way of doing this, and that is to climb to the top of the highest crest available and take a forward and backward bearing along the line of crests. This operation takes a great deal of time and breath, but it is quite certain that no other method gives results of the slightest value. I found my estimates made from points under the top of a crest as much as 5° out on an average. From my observations of the direction of numerous dunes, I am inclined to doubt whether they are grouped with the regularity that has been claimed to exist. Frequently one *seif* will occur, running at a distinct angle to the line prevailing in the neighbourhood. Another interesting feature about these *seifs* is that, whereas they are generally to be found near the summit of whaleback dunes where these exist, yet they never quite coincide with the line of the latter, *i.e.* they leave the whaleback at some point in their course and frequently descend into the trough between two whalebacks. The tendency of the southern extremity of *seifs* to veer off to the east has been noted before, but I think that no explanation has hitherto been offered. I believe the most pertinent fact to be that the south end of a *seif* is usually much smaller in bulk than the rest of it. The consequence of this would be that a westerly wind would move it at a faster rate than the higher portions of the dune. A confirmatory piece of evidence is the fact that where a col of any length occurs in a *seif* it is usually lying slightly out of alignment with the rest of the *seif* and always farther to the east. The prevailing wind in the sand sea is held, on good authority, to be in the direction of the dunes, *i.e.* 340°–160° true. My own experience is slight, but during the thirty-five days I spent among the sands, on five alone was the wind from this direction. The prevailing wind was almost due west with a tendency to south. Clayton, of the Desert Surveys, whose experience of these wastes is second to none, told me, as his considered opinion, that west was the prevailing wind. If this should prove to be the case it would seem to modify the existing theory of dune formation. A further suggestive piece of evidence is the fact that it is very much easier to cross the sands from west to east than in an opposite direction, the east gradients being much steeper. I suggest that the difference between the direction of the lines of cascading crests and those of the whalebacks may be attributed to the comparative mobility of the former, combined with a change in the direction of the prevailing wind over a vast period of years. Possibly the prevailing wind during the immense period of the formation of the main dune feature was in the longitudinal direction of the dunes; but surely it is possible that a radical change in the direction of the wind has taken place and that what is in process of happening is the adjustment of the dune formation to the new wind direction?

At 1.20 p.m. on this first day of our western march we reached the summit of the seventh crested dune from Bir Abu Mungar. The aneroid showed a height of 700 feet above that of Mungar. Looking west from this dune, I saw a line of rocks and crags stretching south-west from El Guss Said. I took a number of bearings to prominent features and made a rough sketch while the camels were catching up. Some miles ahead a long and very high *seif*, lower to the north, was visible. The seventh line of crests, on which we stood, was seen to be very chaotic, and frequently to break up into several parallel lines. The general direction of these was 154° true. We descended a drop of 230 feet before reaching the bottom of the valley separating us from the plateau of crags. The soil here appeared to be decayed limestone. We took advantage of a gigantic shoot of sand lying between limestone cliffs, to climb to the top of the plateau, which the aneroid showed to be at the same height as the preceding *seif*, or slightly over 700 feet above water-level at Bir Mungar. This plateau proved to be formed of limestone and marls, and the surface had been carved by the sand-bearing winds into the most grotesque shapes imaginable. The photographs I took of this stretch illustrate the gouging action of the wind. The tenacity of the limestone in this intensely dry climate allows it to be ground to a razor edge without collapsing, and countless whetted discs, an inch or two in height, stand erect along the cracks and emit a metallic tinkle when crushed by the foot of the traveller. Another curious phenomenon is the suggestion that the surface has been subjected to intense heat. It is profusely covered with black nodules that have the appearance of cinders. Possibly this effect may be attributed to the action of the ferric oxide of the sand on the limestone. The desolation of this high and ghostly waste of grey rock has a powerful effect on the imagination. Suddenly transported there one would suppose oneself to be on the moon. Here and there however, in the fissures and cracks, a small shrub may be found, generally dead. They proved most useful for firewood, and, when green, for fodder. Tufts of grass, too, are not uncommon.

It was here that I descried my first stone artefact, a mousterian palaeolith. It was lying on the bare rock on what had the appearance of an ancient road marked by tracks in the rock running at 192°–12° true. I came to the conclusion however that these were due merely to erosion along the lines of jointing at right angles to the strike of the rock. This angle should be noted because I found it to be universal in all the limestone formations I encountered. Every few miles the imagination of the traveller is stirred by what appears to be the remains of an old track, a long depression or series of parallel depressions a foot wide, filled with sand, continuing as far as the eye can see in both directions and frequently edged with vegetation. These must not be mistaken for tracks. They are nothing more than the weathering of the rock along the lines of jointing.

After traversing this extraordinary waste, we scaled the *seif* on the far side and found before us a second expanse of limestone plateau, covered with craggy formations that reminded one of anthills. This plateau was 50 feet lower than the first. We descended into it as the sun went down, and, after stumbling on for a couple of miles, found a bed of sand silted up against a line of rocks, and there made our camp. We had marched only 19 miles in ten hours.

The morning of the 12th dawned calm and benign after a cold night, and we were away soon after sunrise on the same general bearing of 276° true. After marching 4 miles we climbed a high *seif* dune (the ninth encountered) running at 163° true, aneroid reading 1944 feet, or 660 feet above Mungar. From the top of this plateau an expanse of the plateau of El Guss Said of about 12° extent was clearly visible at 30° east of north. There was another long expanse of fairly even decaying limestone between this dune and the next to the west. We trudged painfully through the heavy powdery sludge that covered the surface here. This mixture of sand and decomposed limestone is frequently over a foot in depth, yet its surface is covered with stones and pebbles of the cindery appearance before referred to. There are more of these on the surface than under it. As the top 3 inches is usually pure sand, which must have been carried there by the wind, whilst the pebbles are limestones or marls from the floor, there would seem to be a tendency for the sand to lift the stones on to its surface and carry them there. A large stone left on the surface of a dune will remain on the surface although the sand in the neighbourhood is continually moving. This might be explained were the effect of the stone to form air eddies that would lower the level of the surrounding sand. But this is not the case, the level of the sand being invariably unbroken in the neighbourhood of the stone. The next *seif*, the tenth, was over 3 miles away. It runs at 170° 30′ true. The aneroid reading at the summit was 1930 feet. A double *seif* lay at a distance of a mile to the westward. Crossing this we traversed a rocky limestone floor for nearly 4 miles until we met the twelfth *seif* and halted on the summit to allow the camels to catch up. The aneroid showed a drop of 40 feet below the ninth dune crossed.

All this time Es Senussi was jogging along at a beater's gait just beside me. I was pushing the wheel and choosing the line of march, while the camels, walking free and untied, followed in the rear. The weather had been fine, the wind light and from the north-west. Clouds frequently filled the sky, but there was no rain, and I was able to entertain the hope that the replenishing party would simply follow our tracks back to Mungar. From the top of the twelfth *seif* a distant prospect of the sands to the west was obtained. They swelled gently upwards with occasional crests. The immediate prospect was of a valley bottom about 4 miles wide, filled with curious rock formations resembling chessmen. From the next dune we saw a high *seif* 4 miles ahead, separated from us by a valley similar to the one we had just left. We marched on without waiting for the camels, and the sun went down just as we reached the shelter of the dune. Here we had perforce to halt until the camels should arrive. There was no sign of them, and shouting and whistling elicited no response. I had taken the precaution of carrying with me an electric torch. I now gave this to the Senussi, who went back on our tracks, while I sat down on the soft sliding sand to wait. After half an hour I heard an answering shout, and in a few minutes the whole party arrived. They had veered off our tracks after some firewood and had failed to find them again. There is some danger in marching ahead of one's transport in these wastes. If anything does go wrong there is nothing to be done but to attempt the impossible feat of returning to the oasis without food or drink. The night was a cold one, as usual. The following day, February 13, we made an uneventful march, crossing thirteen *seifs* in all. After the twenty-second crossed these crested dunes began to grow shorter in length, averaging from 1 to 3 miles as compared with the 10 or 12 miles of the easterly dunes. They were closer together than on the first two days, averaging little over a mile apart. In the valley bottoms the limestone was still exposed, although occasionally completely submerged in sand.

Between the twentieth and twenty-first *seifs* we set up a mark composed of some sandstone rocks we found in the valley bed; and on the east slope of the twenty-first dune we found camel droppings of uncertain age. The animal was apparently *tibn*—or straw—fed. As the whole of this area is on the way to nowhere and unknown to the Arabs, this find was something of a mystery. I made the following note on the summit of the twenty-third dune: "outlook, dunes in all directions—nearly all interspaces sand." The only other feature of interest encountered during this day's march was the trunk of a tamarisk, some 6 inches in diameter. Nothing approaching that size could grow in this area to-day. This phenomenon is to be found between the nineteenth and twentieth *seifs*. I have marked its position on the map. The floor height which the aneroid showed at round about 1650 feet throughout the day rose to 1818 feet before the halt for the night.

The next day, February 14, we marched on approximately the same bearing for 11 miles. As we went on the stony interspaces between dunes died out and the *seifs* became fewer, giving place to rolling sands of indeterminate formation. This was the day on which we had to make our dump and send back the replenishing party. As we drew near to the appointed area it became evident that no prominent features existed that might act as a landmark to guide us back to the dump, and I was forced to choose for this purpose a high roll in the sands visible from a distance of 2 or 3 miles in all directions. Here we barracked the camels, and I set up the theodolite with a view to taking observations of the sun for time preparatory to finding latitude that night.

The return party, consisting of Abu Bekr Guwaya and Abd Ar Rahman, reluctantly prepared for an immediate start for Mungar. Somewhat mollified by a farewell cup of tea, they presently bid us a pious farewell, and were soon hidden amongst the eastern sands. On this day we encountered the first traces of bird life. Some 2 miles from our start I noticed two hawks perched on the summit of a solitary crested dune. They flew off as we approached, and I found a quantity of feathers belonging for the most part to small birds of the wagtail variety, but there was one large green feather that must have belonged to some species of drake. A little farther on I picked up the skeleton of a crested crane. We encountered several brilliant green shrubs, usually growing halfway up a whaleback dune. They were very bitter, and the camels ate sparingly of them. To overcome the difficulty of fixing the legs of the theodolite in soft sand I inserted them in buried biscuit tins. I found this method fairly satisfactory.

Soon after sunrise on the 15th we set out again. The morning was warmer than usual, the thermometer reading 70° F. at 10 a.m., in place of the 60° usual at that hour. The wind had veered round to 10° south of west, and wind-borne sand was tracing long pale lines across the surface of the desert. I hurried on ahead of the convoy, now reduced to two men and five camels, and presently descended into a valley whose bottom was partly uncovered and was formed of a hard white glittering rock which could be scratched with a penknife. Two conspicuous red sandstone boulders, some 2 feet 6 inches high, and liberally covered with birdlime, marked this valley.

Beneath one I found a solitary egg, about the size of a bantam's, mottled closely all over with brick-red and sienna. On the rock beside it sat a hawk or eagle with white breast and dark-brown wings, about the size of a peregrine. This has been identified by the British Museum with *Falco Biarmicus Tanypterus*, the Nubian Lanner, which is the usual falcon in Sinai and Egypt, but does not extend west of Alexandria or to the oases of the Western Desert. The foot agrees best with this bird, but it might be the Barbary falcon *Falco Peregrinus Pelegrinoides*. Here too I picked up the wing of a buzzard, not identified. The neighbourhood was full of jerboa holes and tracks. The means of subsistence of the latter is something of a mystery. I suggest that they feed on the desert silver wings and a four-legged spidery insect which abound everywhere, and which presumably derive their moisture from the atmosphere. The diet of the hawk was revealed by the numerous skeletons of birds of all sizes that lay scattered about. Among these were no water birds. Several appeared to be some kind of partridge. I took two skeletons of these, but they were unfortunately left with some empty tins at one of our camps.

On the summit of the *seif* immediately west of these rocks I noted: "All this country is a confused mass of irregular sand formations, traversed by short and intermittent *seifs*." Towards evening we entered an area more prolific in *seifs*, under one of which we camped for the night. We had marched 20 miles since breakfast. In the afternoon a complete calm fell on us, making the going in the hot sun very exhausting.

The following day we marched on over similar open country for 10 miles. The going was too undulating to be good, and we were continually having to circumvent steep gradients, that would suddenly confront us without warning. We met with an occasional dead shrub, and, here and there, traces of bird life. We halted at 2 p.m. to water our camels, which showed signs of exhaustion. I had intended to keep the water I had reserved for this purpose until we had reached the westernmost point of our march, but it was obviously better to depart from this plan and to relieve the camels of the weight of water and fantasses at once.

During the night a wind sprang up from the south-west and we awoke to find ourselves half buried in sand. Our tracks of yesterday had completely disappeared and the landscape was partially obscured by flying sand. A heavy haze hid the sun and the horizon until 8 a.m. The Senussi informed us that he had always understood these phenomena to occur when travellers approached the neighbourhood of Zerzura. He said that it was due to the action of the Djinn who inhabited that spot. Thus encouraged we marched on, and, after covering 3 miles of undulating sand, crossed a high *seif* that was moaning faintly in the wind, and throwing off a spray of fine sand from its razor edge. A black object on its western face attracted my attention and proved to be the carcase of a camel. It lay within a few feet of the top of the crest, almost completely uncovered. The sand around was stained with an oily substance and had become as hard as rock. It is impossible to say how long the carcase had lain there. It was completely desiccated, the hide still covered with hair, and the pads of the feet whole. It might have been there for ages, and, with nothing to hasten decay, must have lain a good many years to reach the state in which we found it. I could find no distinguishing marks on the hide although I searched for them.

All this day the wind rose, veering to the south, and the flying sand stung the exposed portions of our bodies and obscured the landscape. The mental discomfort of marching under these conditions was great. The camels liked it even less than we did. They had a miserable tucked-up appearance, and they huddled together in a bunch. During every day on which sand blew on my march the temperature rose. The wind on these occasions was always south of west or due south, and a heavy haze hid the horizon, sometimes to a height of 15°.

We marched on, avoiding the short *seifs*, over rolling sand. Owing to the obscurity I had to abandon my practice of marching on a point ahead, and, handing over the wheel to Es Senussi, marched with my compass open in my hand. Occasionally the monotony of the sands was relieved by patches of gravel, lying on a bed of fine white sand, possibly quartzite. I hoped that these pebbles would retain our impression, but except in one instance, all traces were obliterated a few hours after we had passed. From the top of a *seif* crossed in the late afternoon we had a glimpse of a land of more numerous *seifs* to the south-west. Where we were marching the country remained very open. At 3 p.m. the temperature was 80° F., and the sun obscured. Shortly afterwards we crossed a well-marked line of *seifs*, on whose slopes we found two or three green bushes. The sand and wind had delayed us and we marched on for an hour in darkness to make a total of 19 miles for the day. We camped in a trough in the sands, and with the aid of boxes and fantasses contrived a fair protection from the wind. The aneroid read 880 feet above Mungar.

On the morning of the 18th I awoke to find a quail resting among my water-tanks. It flew off but settled a few yards away, as if tired and uncertain where to go. The wind had veered round to west again and was milder. There was fog over the desert. Realizing that our achievement was even less than I had expected, I had altered our course northwards to 300° true, in order to reach the area I had marked as the possible site of Zerzura. We set out therefore on this bearing, and presently came to a steep bank that forced us northward. On mounting the summit of this feature I saw amidst drifting sand a black blob at 12° true. Thinking it must be a rock or tree, I turned and marched on it. As we drew near its appearance became more intriguing, and, suddenly, I saw it was a car. I was exceedingly surprised and not a little chagrined to find the hated symbol of civilization in a place to which I had penetrated with so much labour and effort. It proved to be E.G. 1269, belonging to the Desert Surveys of Egypt. It was standing on a prominent mound, apparently derelict, and the wind was already carving caverns beneath its wheels. The engine started easily, so it was evidently to be called for, and I left a note lashed to the wind-screen and addressed to Clayton, to whom I assumed it belonged, giving my news, and regretting that we had not met under such unusual circumstances. I further asked him to make a note of the longitude and height as an invaluable check on my computations.

That done, we resumed our march on our bearing of 300° true. From time to time I recognized with dismay the half-obliterated tracks of Clayton's cars in the shifting sand. Green bushes became very numerous in the bottoms, and the stretches of gravel on white sand, called *serir* by the Arabs, more frequent. *Seifs* were few and insignificant. As we went on the wind increased until we were marching blindfold into a whorl of stinging sand. As the last of the daylight was fading, something black and formidable loomed up ahead, and soon afterwards we met an unsurmountable *seif*. Hoping to find shelter in its lea, we chose a suitable place on the *serir* and made camp. We were in an eddy and handfuls of sand were thrown about like snowballs in all directions. Perhaps even so it was better than the open. I added grapefruit and sand to dates and cod-liver oil for the evening meal, and the Senussi, after a number of failures, contrived to get a fire alight beneath some water-tanks and made some tea. The dune under which we lay all night never ceased to whine. In a high wind a *seif* makes a noise like that emitted by a glass funnel placed over a bunsen burner and magnified a few million times. I slept badly, kept awake by visions of a storm lasting for days. I found that one of our remaining tanks had lost half its contents from leakage through the screw top, unreported by the Arab who watched it happening, so that we had enough for ourselves for seven days and no more.

By dawn the wind had dropped, and although the sun was invisible and the air still filled with flying sand, it was possible to see where we were. Realizing that we could not travel very much farther westward I left the camels where they lay, and went on myself across the dune for a while. It grew clearer every moment, and by 9 a.m. I could see some miles ahead. I was on a great expanse of *serir* with no more *seifs* visible to the west. The Senussi said he recognized the country as belonging to the type traversed by the Siwa–Kufra direct road, and that it marked the western end of the sand sea. It will be seen from the map that this line is the continuation of that marking the western extremity of the dunes on the Kufra road, as described to me by the Senussi. Although personally satisfied that the sand ended here, I did not take it as proved before meeting Clayton. He had been as far as the frontier and had come to the end of the sand sea on about the same line. Now that our enterprise had failed there was nothing to be done but to retrace our steps to the dump and try again on a south-westerly bearing.

Although I had marched the last 15 miles blindfold I was successful in finding my way back to Clayton's car by the use of my log book. In fact, in my dread of losing the way, I found that I had noted many more features, and with greater accuracy than was normally the case, and I had no difficulty in retracing my steps. We found the car half overturned but no sign of Clayton. My message was still tied to the wind-screen, and there I left it. It had been my intention to return by a different route, but knowing that the sandstorm had obliterated all tracks and might have buried the dump, I did not dare to leave my log line. I could, of course, have taken a latitude when near the dump, and made reasonably sure of hitting it off, but it was taking a chance, and, as events showed, an impossible one.

On the way back I amused myself by taking short cuts. I was able to do this owing to the fact that the going from west to east is very much easier than in the opposite direction, the eastern gradients being very much steeper than the western. My mind was continually occupied with the problem of the origin of the soft patches that occur continually and without apparent method all over the surface of the sand. Sometimes these patches are not more than a foot wide, in which case they are usually several feet long; sometimes they are circular with a diameter of anything between a couple of feet to 100 yards. In the middle of these larger patches solid spots, a yard or so across, will occur. Some patches will give beneath the foot of a camel but remain firm to the tread of a man. I observed many hundred of these spots and arrived at the following conclusion: that while it is impossible to tell from the appearance of a sand surface that it is not soft, spots occurring in all types of surface, it is frequently possible to say that it is soft. When there are a number of grains on the surface larger than the prevailing size, and particularly when there is purplish appearance, the odds are that the sand is soft. This purplish appearance is due to the colour of the large grains, but I believe it is only apparent when the size of the smaller grains with which they are mingled is smaller than the average size of grain in the sand sea. This gives them a whitish appearance, why, I cannot say, but it is so, and this whitish hue emphasizes the purple tint of the large grains, which do not normally show up from any distance. Thus when one sees a purplish patch one may say, firstly, that it will be soft, and secondly that it consists of a mixture of exceptionally large and exceptionally small grains, that is of grains of very unequal sizes.

There are two types of sand to be found in the sand sea. One, the prevailing type, is very rounded, the colour of yellow ochre, and almost invariably uniform in size. Cascading crests are invariably formed of this type, and so are the great majority of whalebacks. The second type I will call the underlying type, as it is only found emerging from under the main dune and rolling sand formations, frequently in the troughs between dunes, but mainly in wide flat expanses, more especially near the western verge of the sand sea. The bulk of it is composed of grains smaller, whiter, and much less rounded than the first type. Sometimes these grains are so small as to resemble a white dust. Large irregular grains and gravel are very apt to be found with it. These facts seem to suggest that the main dune formations of the sand sea are an importation of later date than this underlying sand, and that they have been subjected to the action of the wind to a much greater extent.

At 9 a.m. on the second day of our return march we were just about to strike camp when we heard the sound of an internal combustion engine approaching over the dunes behind. A moment later a Ford box glided over the summit of the whaleback, and Clayton, armed with a twelve bore, got out. He had seen our tracks and camel droppings next his car on his return that morning, but had failed to find my note, and so was prepared for anything. He told us that he had made a camp in the hollow under the sand mass on which the car rested, with tents pitched and a man in charge. It seemed incredible that we could have missed it twice in succession and illustrates the ease with which one can get lost in these sands. We had a long talk, sitting on the sand in the sun, and he told me about his wonderful expedition into Gilf Kebir, *via* the frontier, with three Ford cars. He had got into a corridor between dunes 200 metres high, and, on one occasion, after going 70 km., had come to an unsurmountable barrier, and had had to turn back. This occurred on his way home and ran him so short of petrol that had it happened again he would be there to this day. He had actually traversed the very area

I was proposing to search on my second attempt, and we agreed that my doing so would serve no useful purpose.

The remainder of that day we marched on the log reversed, hoping to hit off our abandoned and empty water-tanks by dusk. Darkness found us uncertain of our whereabouts, and I was forced to spend half the night in trying to get a latitude. It was cloudy and the most suitable stars were already past the meridian. However I at length succeeded in getting a result which showed that we were on the same latitude as the tanks, and must therefore be east of them. The morning revealed them black and conspicuous, a couple of miles to the rear. We had passed within 200 yards of them.

The rest of the march back to the dump passed uneventfully enough in calm and pleasant weather. On the afternoon of the 22nd we reached a point which we recognized as being in the neighbourhood of the dump. There was no sign of the latter, although it had formerly been visible from this point, and we were marching straight past it when, on glancing to the left, I saw a black object in the sand about 200 yards away. This proved to be a water-tank lying on its side, and this was all that the storm had left visible. The rest of our tanks and stores was buried. We found that one fantass had been turned over on to its bung and most of the water had escaped, but the rest were intact. There was no sign of Abu Bekr and the camels, so I busied myself in making landmarks to attract their attention. They arrived the following morning. They explained that when the sandstorm occurred they had been at Mungar. They had assured each other "Certainly the Bimbashi will not march to-day," and from this erroneous deduction had concluded, quite illogically, that I would arrive a day late at the dump. Had I still cherished my first project, this would have been infuriating; as it was it mattered very little.

On the return march I was careful to take a number of bearings along the top of *seifs* to check my previous findings. On several occasions I found a difference of 10° between adjoining *seifs*, but there was a general direction for *seifs* west of a line about 20 miles west of Abu Mungar, that I found to be 165° true. Occasional departures would occur in excess of this angle, *i.e.* towards the north and south line, and the difference might be as much as 10°. The dunes lying immediately west of Mungar have a general direction of 158°. Altogether I took thirty or forty measurements, of which the limits were 170°–152° true.

There was evidently little to be gained by adhering to my first intention of making a second journey to the south-west. I was however provisioned for at least another fortnight, and the only question was how to spend this time with profit. At this time I still believed that the track-like grooves in the surface of the rock we had passed on our first day's march from Mungar were the vestiges of an old road. Their direction was intriguing inasmuch as it led to no known oasis, and I felt that in following them I should at least find some traces of the people who had used them. The tracks pointed towards Regenfeld to the south, and would traverse a practically unknown tract of desert. I decided to return to these tracks and make a preliminary investigation for three days while a party returned to Mungar for more water and grain. On their return I planned to follow the tracks to the south for as long as my supplies and water held out, and then to march back to Dakhla.

The march back to the tracks was uneventful. Tempers were short and it was here that I first discovered the excellence of Abu Bekr Guwaya. He was a perfect peacemaker; never tolerated a quarrel, or would allow the parties thereto to rest until it had been composed; to do which he had usually to sacrifice his own interests. In addition to this he was our cook, tailor, and odd job man. Suleiman Foula, the boy, who had hitherto proved invaluable, and Abdurrahman began to run out of tobacco and relapsed into a condition of irritable melancholia in consequence. I sent them back to Mungar and kept the other two with me.

The day before we reached the tracks I was walking across a stretch of soft sand and pebbles that lay in the shadow of a high *seif*, when I caught sight of something that glittered in the rays of the setting sun. It lay by itself in the centre of a clear patch of sand and in shape resembled a spear-head. This was the second artefact I had found. I spent an hour in searching the neighbourhood, and found two or three more artefacts of similar pattern. This site is marked on the map.

On the morning of the 24th we reached the tracks, and for the next three days I made a thorough search of the neighbouring desert. Shortly to the south of the point at which we had met the tracks was a line of limestone cliffs. Mindful of the opinion of Dr. Ball, that the most promising sites for palaeolithic or neolithic remains are to be found at the foot of cliffs or other shelter from the wind, I conducted a search along the foot of these cliffs for some miles. I found two artefacts only. Possibly the absence of remains may be attributed to the excessive weathering of the limestone, but whatever the reason, not only did I find practically nothing here but the foot of every other cliff I encountered proved equally barren. I formed certain definite conclusions as to the nature of the sites where artefacts may be looked for with every hope of success. These I will describe in due course. We found a number of recent traces of camels amongst these cliffs. From the way in which the tracks branched off to ascend unlikely places, and the existence of a camping place that to judge from the quantities of dung, rope ends, date-stones, and embers it contained, must have been used a great number of times, it is possible that this area is used as a hide for contraband. My Arabs were of this opinion.

On the morning of the 28th we met the returning party from Mungar with the provisions we required for the march, and in the afternoon we said good-bye to them again and marched on a bearing of 161° until dark. I had by this time satisfied myself as to the nature of the "tracks" I had hoped to follow, and had decided merely to return to Dakhla by a detour through the dunes, instead of by the usual road. That night we were tormented by rats. (These have been identified by Mr. Kinnear of the British Museum as *Gerbillus Pyramidum*, which is found all over Egypt, Sudan, the Sahara, and all North Africa from the Red Sea to Algeria.) They ran over our feet, gnawed holes in our grain bags, and generally made the most of their windfall. I woke up to see the Senussi kill the last of them with his bare hands, after a short but exciting chase over the sands. How these creatures support life is a mystery. True we were sleeping on the Kufra road, but even if all the rats were able to find

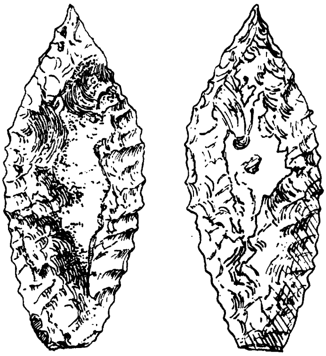


Fig. 1. Two faces of a leaf-shaped point on tabular chert, pressure-flaked, with serrated edges, found at long. 27° 1′ E., lat. 26° 34′ N.; age neolithic

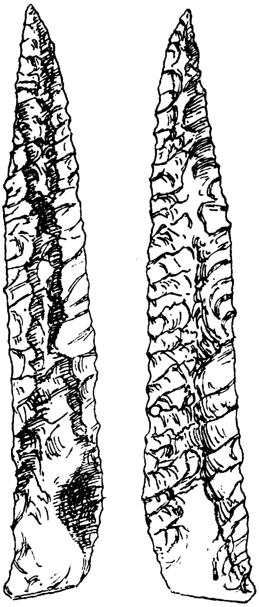
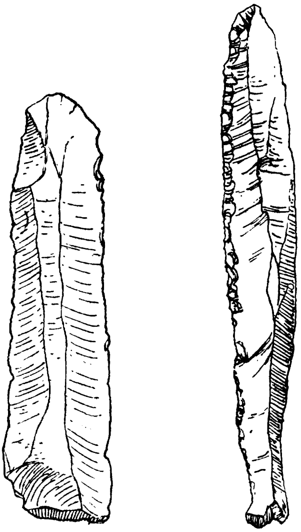


Fig. 2. Two faces of a knife of neolithic age, pressure-flaked from tabular chert, found at long. 27° 31′ E., lat. 26° 16′ N.; the type is dated in the Fayum middens at probably about 5000 B.C.



Figs. 3 and 4. Blades found at long. 27° 31′ E., lat. 26° 16′ N.; age probably mesolithic, or neolithic of Caspian tradition. (These four artefacts are all reproduced here at half size.)

and feed on every party that passes along this road (which is most improbable, as the so-called road is at least 10 miles in width at this point) it is difficult to see how they could in a year rob four or five parties of sufficient provender to last them for the rest of the time. They were in excellent condition, fat and, as the Arabs proved by experiment, tasty. They had no appearance of disease of any kind. I found the magnetic variation here to be 2° west. This value was exceptional, for every other one I obtained was within 20′ of a degree west. The difference is probably attributable to purely local influences.

On March 1 we started off on the same bearing soon after sunrise. We were marching between two *seifs* that lay about 3 miles apart, and very nearly parallel to them. There is very much less sand in this area than to the west. What there is is heaped up into crested dunes of little over 100 to 150 feet in height. Between these dunes the underlying limestone is usually exposed and the curious cottage-loaf and anthill-like formations characteristic of the limestone in these parts are numerous. The general configuration of the desert is very simple here. It is composed of very regular limestone strata, dipping imperceptibly to the north. Every 20 miles or so occurs a regular line of cliffs facing south, 100 feet to 200 feet in height. At the foot of these is more limestone strata, very little broken and scarcely at all disturbed, that extends for another 20 miles or so. This goes on for the best part of 100 miles and possibly farther.

As we marched on, the distance between the *seifs* increased to about $4\frac{1}{2}$ miles. Occasionally the soft decaying mulch underfoot would give place to a hard brittle white limestone full of fossil shells and ammonites. After marching 14 miles we came on one of these patches lying close under the *seif* to the east. It formed a distinct depression as far as the hard limestone in the neighbourhood was concerned. A few hundred yards to the south were a number of well-marked depressions with steep and crumbling sides, formed, presumably, by the action of the wind. The hard patch was marked by the dead trunk of what must have been a fair-sized tamarisk. There was an old growth of wood around the trunk which was perhaps 8 inches in diameter. Round about were two or three mounds. Here we found quantities of flint splinters, ostrich shells, and fossilized sea-shells. I sat down to let the camels catch up, and began idly fingering some of the flint splinters. Suddenly I noticed that many of them were serrated along one edge. I got up and began to search for more. I soon found several pestles and grindstones, and innumerable flint knives. I collected a number of these as specimens. These have since been classified by Miss Caton-Thompson as mousterian palaeoliths.

It occurred to me that a knife factory of such importance should have at least one hearth that would be recognizable as such, and was presently rewarded by uncovering two, that lay concealed under a couple of inches of sand. The ashes covered a circle of about a yard in diameter. No doubt there were others, but I had already spent over an hour in the search and was compelled to go on.

We had not moved 50 yards from these ancient hearths when we came on an oval depression in the ground that, at first sight, resembled nothing so much as a dewpond. Beyond and in line with it were several extensive, ragged depressions, the last over 2 miles in length, and from 20 to 30 feet deep. These had evidently been carved out by the wind. I suggest that in that remote age when the desert was overrun by the unknown race whose flinty tools so numerously besprinkle every spot where the hardness of the rock has defied the agents of decay, which have made the rest of this limestone waste a crumbled and crumbling heap of ruins, nothing can be more probable than the existence of some artifice for inducing condensation of the nature of dew-ponds. When the growing desiccation and dewless nights brought absolute drought these would be deserted, but their site would be the first to invite denudation by the wind, and it is improbable that any positive traces would remain to this day. I suggest that what we saw in this ancient knife manufactory was really a dewpond, and that its presence alone would make occupation by man a possibility. Dew still occurs in the sand sea. We were twice wetted by it.

I came to the following conclusions with regard to probable sites for flint and other artefacts: (1) It is generally a waste of time to search for these in soft decayed soil. Not infrequently I found the large sandstone platters for grinding grain in soft spots, and a search usually revealed the accompanying pestle of hard white-rock, quartzite as a rule, but of flint artefacts there was not a vestige. (2) Whenever a hard flinty patch of limestone is encountered it is well worth one's while to look for artefacts. It is no exaggeration to say that, in this area, they are usually to be found on such patches. (3) These patches do not occur at the foot of cliffs and boulders in the majority of cases, indeed, there is every reason against their doing so. They are generally to be found on the great wastes of flat limestone, in places very little denuded by the wind. It is very probable that the majority of the sites I discovered were manufactories. In most of them the flints from which the artefacts were made occurred in the soil at the place where they were found. Many, too, had an unfinished appearance, and may have been discarded as failures. The quantities of these remains is really very striking. I grew weary of continually finding them in the likely spots. My two Arabs, who supposed that they must possess magical properties, or some other practical use, were continually running up from the rear with a large grinding platter in their hands. One of these was all I wanted, so I threw away the rest on the spot, but I was considerably impressed with their multitude. I kept a record of the number picked up. It was twenty-five. It must be remembered that we were marching in a straight line at as fast a pace as we could maintain, that we were weary and not particularly observant, so that we saw only the most conspicuous of these remains.

That night we encamped halfway down a limestone escarpment some 150 feet in height, that faced south. The escarpment was very much broken and abounded in fantastic castellated effects. The aneroid showed 400 feet above Mungar. Next morning we crossed the *seif* to the east, and began to march up the valley on the far side. This valley was half filled with sand, and as we went on I noticed an extraordinary phenomenon. The sand, which sloped somewhat steeply down towards us from an escarpment in front, was liberally covered with wet patches. These varied from 1 to 10 yards in diameter. They could scarcely have been due to rain, firstly, because there had been none for at least twenty-four hours to our knowledge, and secondly, because, while the patches were wet to the touch, the neighbouring sand was absolutely dry. The whole area was honeycombed with the holes of jerboas and a fair number of tufts of dead grass were sprinkled about. The Arabs were as mystified as I was. I can only suggest that rain had recently fallen over the whole area, had collected on the surface of the limestone, and was emerging at the surface at various points in the sand slope. The sand was damp to a depth of 2 or 3 feet under the patches, which was as deep as we could dig in the time.

We marched on for another 12 miles over rather more broken country than we had yet met with. The *seifs*, which were very low, began to close in on us. Early in the afternoon a prominent limestone escarpment running in the usual direction leaped into view to the south-west. At about the same time I noticed several parallel lines of grass tufts running at 190° true crossing our line of march. I followed them for a mile and they continued. There were no tufts visible to either flank, and I inferred that these might mark the tracks of some ancient road. The road to Kufra is marked in this way in places and it seemed the most reasonable explanation. I decided to follow the tracks for as long as my provisions would hold out. I was confirmed in my belief that I was on a road by the discovery that the line carefully circumvented dunes and other obstacles, and that it led up to a very prominent sugar-loaf rock of limestone 40 feet high that would be visible from half a day's march to the south-west. We camped for the night on a stretch of sand north of the beginning of a *seif* and about 3 miles from the next *seif* to the west, the Arabs somewhat cast down by the receding prospect of Dakhla and rest. A serious situation was arising with regard to food. I had enough dates and biscuit to last me two days. After that I should have to rely on a small quantity of wholemeal flour I had kept, perhaps 2 lb. The Arabs were no better off. They had finished their sugar and were sweetening their tea with some extremely dirty dates. However we had plenty of pulse for the camels and so were in no danger of starvation.

The aneroid showed our height this night to be 490 feet above Mungar. We were on a vast flat expanse of limestone thinly covered with sand. The following morning, March 3, we started on a bearing of 190° true as before, the lines of tufts still keeping pace with us, and after marching for 6 miles began to ascend what proved to be the eastern edge of a mass of chaotic *seifs* running at 162° true. On the way we were suddenly thrilled to observe what appeared at first to be an enormous herd of antelope coming over the sand about a mile ahead of us. As they approached we saw that they were birds, flying in a perfect wedge-shaped formation about 20 feet above the surface of the desert. They approached rapidly to within a couple of hundred yards and then wheeled half-right and were soon lost among the northern sands. As they passed with a heavy flapping of great wings I knew them for crested cranes, —gharnuk, as the Arabs named them. By this name, too, are they known in the Sudan. The direction of their flight when first we saw them was almost exactly that of 'Uweinat, continued to the north it meets the west branch of the Nile Delta at the coast. Possibly the flight would rest in the oases of Farafra or Bahariya by the way. Could they have flown straight here from Erdi, 550 miles, or did they rest by the way in Gilf Kebir? They had certainly not come from the Nile valley. It is quite evident from the number of hawks that inhabit the sand sea alone (I saw twelve, all of the same species, the size of a peregrine, with white breast and dark wings) that the whole area is continually traversed by migratory birds at this period of the year. The fact that I found an egg, new laid by one of these hawks in a scooped-out hollow in the sand under a rock suggests that the season of most profitable hawking must have been beginning towards the end of February, and must have been expected to last at least until the resulting chick had acquired the strength to fly to better hunting grounds, say three months at a minimum.

After traversing a wide sandy plain with frequent patches of soft and hard limestone, the latter almost invariably containing a flint artefact or two, with occasional flat, round, hollow discs of a hard sandstone, reddish in hue,which were probably used to grind grain, we began to climb a *seif*. Halfway up we met the grass tracks again, very flourishing here. Two tufts especially had retained their full stature of 18 inches, and were very bushy and plentiful. On the top of the *seif* sat a hawk with black wing tips. His breast I could not distinguish in the glare. Directly we had topped the *seif* we found ourselves in a chaotic mass of crests, perhaps 2 miles wide. Tufts of perfectly fresh green grass were numerous among these crests. We emerged the other side to find the usual flat expanse of limestone desert with occasional cliffs. Our line of 190° true pointed straight at a high outcrop on the horizon. The next *seif* to the west was several miles away.

The march to this Gilf was uneventful. I reached it a full hour before the camels but was disappointed to find nothing there of interest. A strong wind was blowing from the south-west and the sand was rising. I chose a camp for the night and prepared to take a latitude. I found my latitude to be 25° 29′ 19″, taking three pairs of stars and getting very accurate results. I plotted in the march and found the longitude to be 27° 29′ 40″. This value was roughly checked by the ensuing march to Dakhla and was approximately correct. The aneroid read 700 feet above Mungar. Ahead lay Regenfeld and fairly well-known country. There seemed little to be gained by going on, especially as our food was running out. Qasr lay at 81° true, according to my calculations, and thither we now turned our steps.

On the morning of March 4 we set out across the limestone desert that separated us from Qasr. We marched for 8 miles before reaching the first *seif*, running at 158° true. This was a double *seif* at this point. At its foot I picked up some bird remains, the skeleton of a crested crane, and the foot of the short-eared owl, *Asio Flammeus Flammeus*. I am informed by Mr. Moreau the ornithologist that this is the first time the latter bird has been identified so far in these deserts. Half a mile farther on was a second *seif* running at 160° 30′ true, and 2 miles beyond a third *seif*. These *seifs* were separated by stretches of limestone and marls. Brilliant white pillars and shelfs began to appear, and made convenient landmarks on which to take bearings. The predominant feature in this stretch was the prevalence of a tough and wiry shrub that grew in the joints of the rock with a profusion that was as unexpected as it was welcome. We were badly in need of firewood, and here was fuel for an army. The magnetic variation here was only 15′ west. As we went on the ground fell slightly to the east, the wind veered to north-east, an unaccustomed quarter, and the cold was such that I was glad to wear my mackintosh in the heat of the noonday sun. There was very much less sand here than to the north-west. What there was was all swept up into low and short *seifs*. We camped for the night of March 4 in the shelter of an overhanging crest, in the soft sand.

At dawn on the 5th I climbed the sheltering crest to scan the eastern horizon. The massive Glif that runs all the way from Mungar to Dakhla was plainly visible. At sunrise we marched on the same bearing. After a rapid walk over hard limestone, we crossed a *seif*, double at this point and running at 158° true, from the top of which I recognized Jebal Edmonstone at 81° Magnetic. We were marching on the very point to which I had measured the angle from the map. Ahead was a single group of low *seifs*, beyond which we could distinguish a confused mass of hillocks and hollows, mingled with brilliant white pillars and shelfs of limestone. We marched on over these ultimate *seifs* into a country of broken limestone formations, with marls and occasional sandstone. Crystals of calcite frequently occurred in this stretch.

And now, for nearly 30 miles, we marched through duneless country, a very desolate land of innumerable limestone hillocks. Every here and there we would find an artefact, but the march was as devoid of interest as it was of hope. Ahead lay Dakhla and ignoble ease. Behind lay all our dreams, and all the endless promise of the sea of sand. On the morning of the 6th we met the dunes again. By the map they were long overdue. There was no wind, and the sun was a ball of torturing flame throughout an endless day. I was determined to reach the sound of human voices before night, and when sunset found us on the verge of the final group of dunes that flank Jebal Edmonstone, I sent Abu Bekr Guwaya ahead, on one of our lightly laden camels, to give warning of our approach and to prepare the first meat we had tasted for five weeks. He rode away from us through these dunes in miniature, much to the chagrin of Es Senussi, who felt that he was the proper person to dispatch on such an errand. These dunes are wrongly marked on the map. Their eastern verge runs at 180° true. They are much redder than is usual, or they appeared so in the rays of the setting sun. I let the Senussi drive the camels, and followed some distance in rear. They were very attractive dunes. After the giants of the sand sea they seemed playful. One could take liberties with them.

Gebel Edmonstone kept its distance with customary obstinacy, and it was after midnight when we reached the friendly shelter of Sheikh Maihub. We had marched 38 miles since sunrise. Near the well Abu Bekr was busy broiling a turkey with rice, and, for the last time, I dumped my boxes on the sand and made my bed beneath the stars. I had finished my preparations for the night and was peacefully enjoying my nightly indulgence in the mellow periods of Hume's 'History of England,' when I was called to partake of Dakhla hospitality. The three of us sat down to meat and said not a word until the last of the turkey had gone to make good the abstinence of five weeks. Then we stretched our tired limbs for a last night on the sand. Our enterprise was over.

Next day I enjoyed the luxury of a bathe in the hot spring that perpetually overflows in the gardens of Maihub. Here too I parted, without regret, with certain importunate companions of the march, of whose presence I had been uncomfortably aware for some days. I made an excellent lunch of newly baked bread, an original soup of yolks of egg and limejuice, very piquant, two or three broiled chickens, and a dish of giblets. Mansour Bey arrived in the afternoon in a Ford, accompanied by ten friends from Qasr.

I bade a rather sad farewell to my faithful Arabs, and, after another meal at the Omda's, set out for Bilat with Mansour and Brinz, the son of the Omda of Bilat. As we drove through the pleasant gardens of the oasis I recalled all the abortive effort, the vain expense of strength, of the enterprise, now rapidly receding into the past, and wondered whether I regretted it; whether I would do it again were the chance to offer. Before I had considered it I knew that I would, knew that the experience was real, and that therefore I would always treasure it.

Others have achieved material results far greater, have made journeys more perilous and more spectacular. But no one, going forth in the spirit of adventure, has found more joy and delight in the fulfilment of his enterprise than I did in the failure of mine.

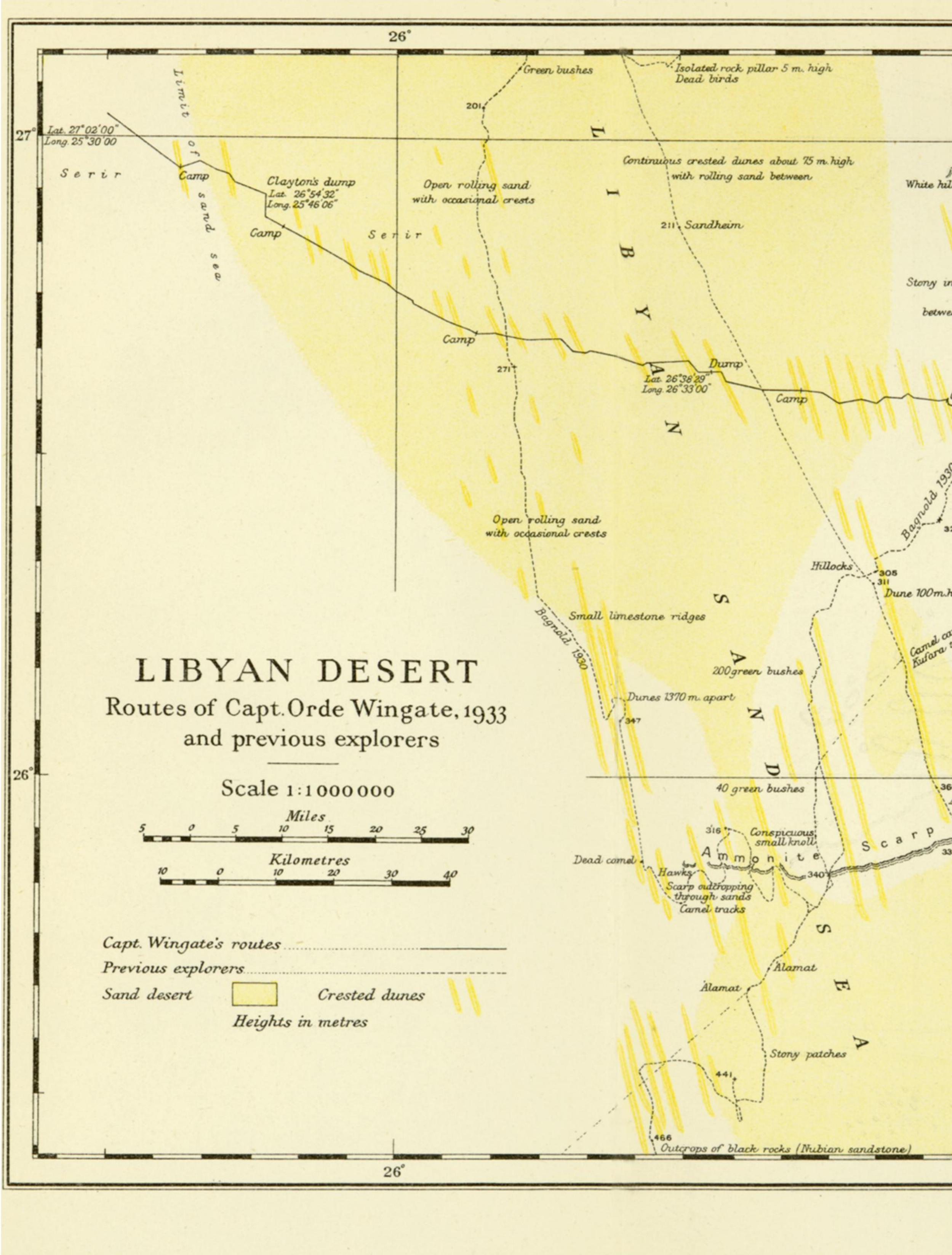
SAXTON'S SURVEY OF NORTHERN ENGLAND

GORDON MANLEY

MOST of our scanty knowledge of Christopher Saxton, the notable surveyor of Elizabeth's reign, is due to the investigations of the late Sir H. G. Fordham. We do not even know the exact date of his birth or death, or how he became a surveyor, or what methods he used. In particular we know very little about his most important work—the survey of England and Wales, which formed the basis for the series of thirty-four county maps published between 1574 and 1579. These in turn provided the greater part of the material for the topographical maps of this country for well over a hundred years.

Suggestions have been made with regard to his procedure, based on considerations of his errors in measurement and of the methods of survey known at the time and likely to be practised by a man working fairly quickly. These appear to point to a series of compass traverses as the basis of the survey over much of the country. There is only one hint to be got from documents of the time. This is found in the letter of instruction to authorities in Wales "to see him conducted unto any towre castle highe place or hill to view that countrey." Bearing this in mind, that at times he may have ascended hills for the view, it appeared to me that a careful inspection of Saxton's mapping of hilly country might afford some results of interest, and that the conclusions derived from his mapping of one region might be tested by applying them elsewhere. I was first led to consider the possibilities of this method of approach on examining the detail of the Pennines on the Durham sheet of 1576. With the aid of the Ordnance Survey maps and a personal knowledge of much of the country, some material has been gathered which may perhaps promise further results. In particular, some conclusions with regard to Saxton's procedure in the Pennines may be tested against his mapping of the Lake District with success.

Some of the more conspicuous insertions and omissions from his maps may be mentioned. Haweswater is altogether omitted and Esthwaite Water is shown only on the Cumberland sheet; and if it is argued that the scale of the maps precludes representation, why were Wastwater and even Devoke Water,



LIBYAN DESERT

Routes of Capt. Orde Wingate, 1933
and previous explorers

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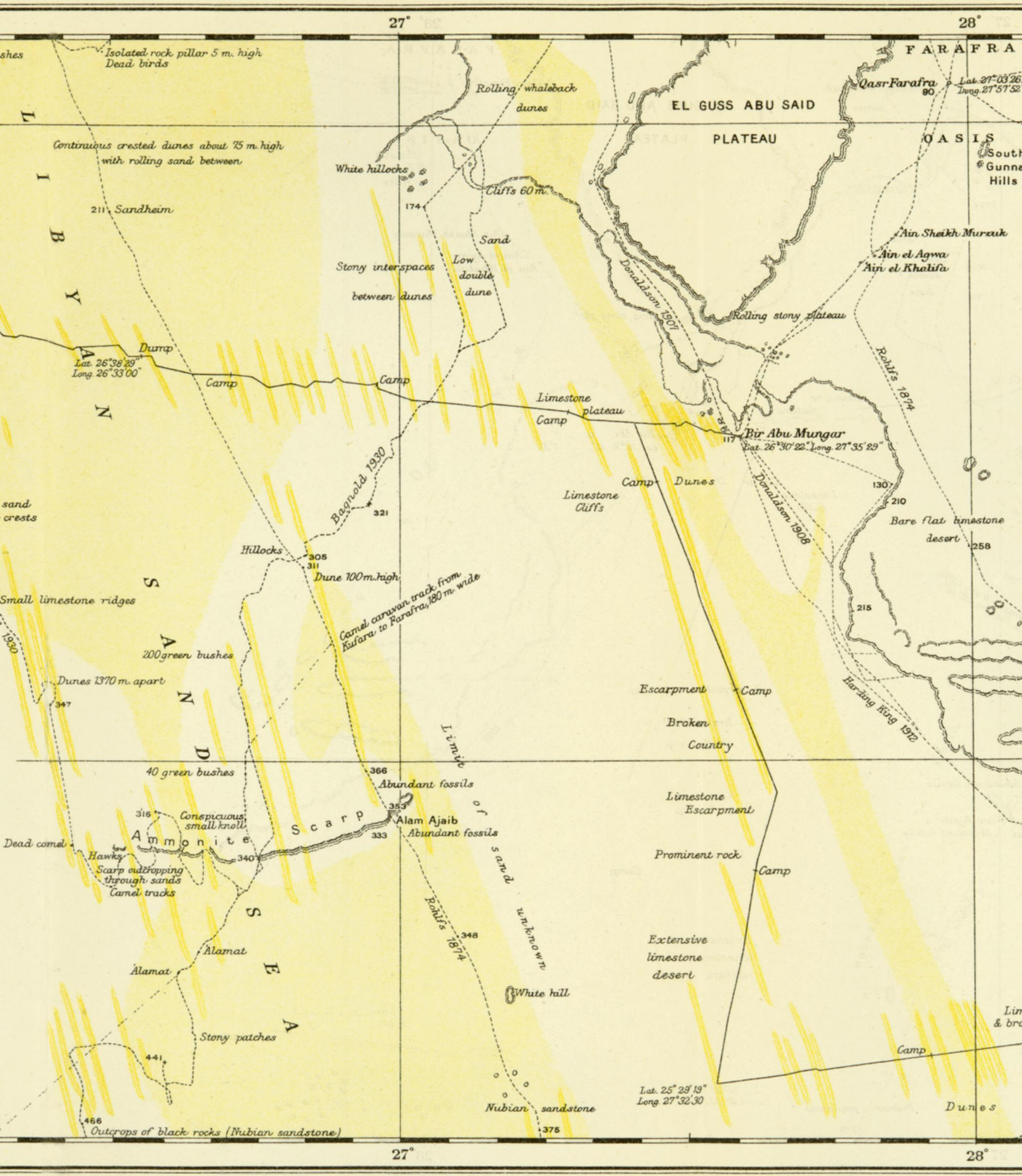

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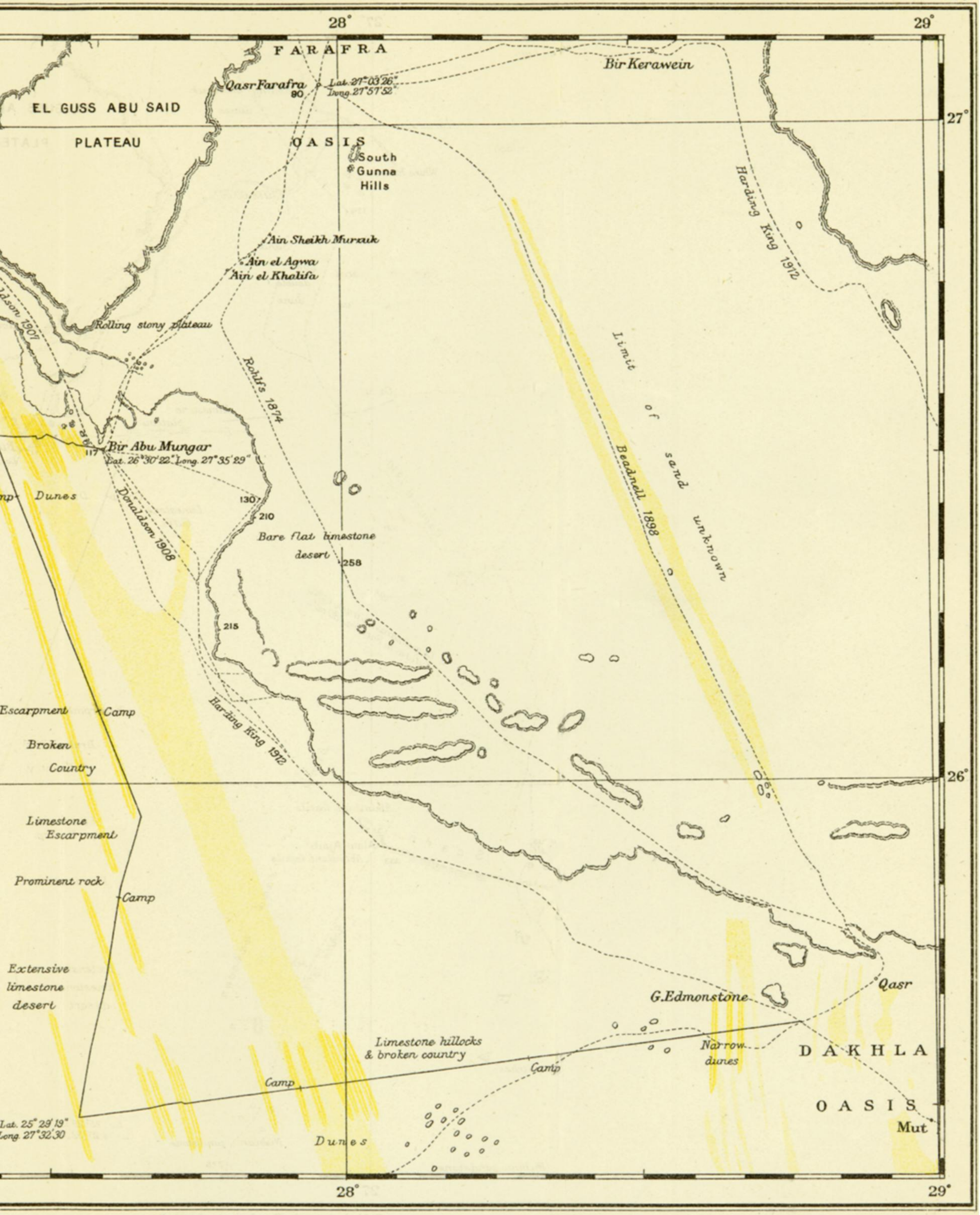

LIBYAN DESERT

Wingate